

## CLAIMS

We claim:

- 5011162
- 09418397-101499
1. A method for removing DTMF signals from audio signals comprising the steps of:  
examining audio signals for potential DTMF signals;  
preparing the audio signals for transmission as digital packets;  
while no potential DTMF signals have been detected, promptly transmitting a  
digital packet after sufficient time has elapsed for a potential DTMF signal  
to be detected in said digital packet; and  
if a potential DTMF signal is detected, temporarily storing digital packets until  
DTMF detection can be performed, and if the potential DTMF signal does  
not result in a DTMF detection, promptly transmitting the digital packets  
that were temporarily stored, and if the potential DTMF signal does result  
in a DTMF detection, discarding the digital packets that were temporarily  
stored and transmitting a control packet containing information relating to  
characteristics of a DTMF signal that was detected.
  2. The method according to claim 1, wherein:  
the step of preparing the audio signals for transmission as digital packets  
comprises preparing the audio signals for transmission as RTP packets.
  3. The method according to claim 1, wherein:  
the step of transmitting said digital packet includes transmitting the digital packets  
over an IP network.
  4. The method according to claim 2, further comprising the step of:  
transmitting the RTP packets over an IP network.
  5. The method according to claim 1, wherein:  
the audio signals include digitized representations of voice signals.

- 1 6. The method according to claim 2, wherein:  
2 the audio signals include digitized representations of voice signals.
- 3 7. The method according to claim 3, wherein:  
4 the audio signals include digitized representations of voice signals.
- 5 8. The method according to claim 5, wherein:  
6 the step of examining the audio signals for potential DTMF signals is performed  
7 using digital signal processing.
- 8 9. The method according to claim 6, wherein:  
9 the step of examining the audio signals for potential DTMF signals is performed  
10 using digital signal processing.
- 11 10. The method according to claim 7, wherein:  
12 the step of examining the audio signals for potential DTMF signals is performed  
13 using digital signal processing.
- 14 11. The method according to claim 2, further comprising the step of:  
15 when the potential DTMF signal does result in a DTMF detection, preparing a  
16 control packet comprising 32 bits of information having a format of:  
17 RRRNNNNNRRVVVVVDDDDDDDDDDDDDDDDDD  
18 where "R" designates reserved bits;  
19 "N" designates bits of data representative of a DTMF digit;  
20 "V" designates bits of data representing the power level of the DTMF signal,  
21 expressed in dBm0 after dropping the sign; and,  
22 "D" designates bits of data indicating a duration for a DTMF signal, in timestamp  
23 units.
- 24 12. The method according to claim 11, wherein:

- 1 the "N" bits of data representative of a DTMF digit are encoded so that the
- 2 following encoded data represents the indicated DTMF digit:
- 3 an encoded "0" represents a DTMF digit of 0
- 4 an encoded "1" represents a DTMF digit of 1
- 5 an encoded "2" represents a DTMF digit of 2
- 6 an encoded "3" represents a DTMF digit of 3
- 7 an encoded "4" represents a DTMF digit of 4
- 8 an encoded "5" represents a DTMF digit of 5
- 9 an encoded "6" represents a DTMF digit of 6
- 10 an encoded "7" represents a DTMF digit of 7
- 11 an encoded "8" represents a DTMF digit of 8
- 12 an encoded "9" represents a DTMF digit of 9
- 13 an encoded "10" represents a DTMF digit of \*
- 14 an encoded "11" represents a DTMF digit of #
- 15 an encoded "12" represents a DTMF digit of A
- 16 an encoded "13" represents a DTMF digit of B
- 17 an encoded "14" represents a DTMF digit of C
- 18 an encoded "15" represents a DTMF digit of D.
- 19 13. The method according to claim 12, wherein:
- 20 the "N" bits of data representative of a DTMF digit are encoded so that the
- 21 following encoded data represents the indicated DTMF digit:
- 22 an encoded "16" represents a Flash.
- 23 14. The method according to claim 11, wherein:
- 24 the reserve bits are set to zero.
- 25 15. The method according to claim 12, wherein:
- 26 the reserve bits are set to zero.
- 27 16. The method according to claim 13, wherein:

- 1 the reserve bits are set to zero.
- 2 17. A method for transmitting audio signals potentially including voice signals and  
3 DTMF signals over an IP network, comprising the steps of:  
4 processing digital representations of audio signals to detect potential DTMF  
5 signals;  
6 in a first mode of operation while no potential DTMF signal has been detected (a)  
7 preparing the digital representations of audio signals for transmission as  
8 RTP packets; and (b) transmitting an RTP packet over an IP network after  
9 a predetermined period of time sufficient to allow the step of processing  
10 digital representations of audio signals to detect potential DTMF signals  
11 to be completed for said RTP packet;  
12 in a second mode of operation when a potential DTMF signal has been detected,  
13 preparing the digital representations of audio signals for potential  
14 transmission as RTP packets, and temporarily storing such RTP packets  
15 while the potential DTMF signal is processed to verify whether it is a valid  
16 DTMF signal;  
17 (a) if the potential DTMF signal is determined to not be a valid  
18 DTMF signal, transmitting the RTP packets that were temporarily  
19 stored over an IP network; and,  
20 (b) if the potential DTMF signal is determined to be a valid DTMF  
21 signal; discarding the RTP packets that were temporarily stored,  
22 preparing an RTP control packet containing information indicative  
23 of characteristics of a DTMF signal, and transmitting the control  
24 packet over an IP network.
- 25 18. The method according to claim 17, further comprising the steps of:  
26 receiving the RTP packets at a remote location coupled to an IP network;  
27 decoding the RTP packets to recover digital representations of audio  
28 signals;  
29 converting digital representations of audio signals to analog signals;

- 1 receiving an RTP control packet at a remote location coupled to the IP network;
  - 2 and,
  - 3 generating DTMF signals having characteristics determined by information
  - 4 contained in the RTP control packets.
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- 5 19. An apparatus for removing DTMF signals from audio signals to be transmitted
  - 6 over an IP network, comprising:
  - 7 a telephony interface;
  - 8 a digital processor coupled to the telephony interface for processing digital
  - 9 representations of audio signals to detect potential DTMF signals;
  - 10 a microcontroller coupled to the digital processor, the microcontroller being
  - 11 operative to prepare the digital representations of audio signals for
  - 12 transmission as RTP packets;
  - 13 memory coupled to the microcontroller for temporarily storing RTP packets;
  - 14 a control register coupled to the digital processor and readable by the
  - 15 microcontroller, the control register including a flag bit indicative of the
  - 16 status of detection of a potential DTMF signal, the control register
  - 17 including one or more flag bits indicative of the detection of a valid DTMF
  - 18 signal;
  - 19 a network interface coupled to the microcontroller for coupling RTP packets to
  - 20 an IP network; and
  - 21 wherein when the flag bit indicative of the status of detection of a potential DTMF
  - 22 signal is not set, RTP packets are promptly coupled to the network
  - 23 interface for transmission over the IP network, and when the flag bit
  - 24 indicative of the status of detection of a potential DTMF signal is set, RTP
  - 25 packets are temporarily stored in the memory while the digital processor
  - 26 performs additional DTMF detection processing, and if the flag bit
  - 27 indicative of the status of detection of a potential DTMF signal is reset and
  - 28 a flag bit indicative of the detection of a valid DTMF signal is not set, the
  - 29 RTP packets temporarily stored in the memory are promptly coupled to
  - 30 the network interface for transmission over the IP network, and if a flag

1 bit indicative of the detection of a valid DTMF signal is set, the RTP  
2 packets temporarily stored in the memory are discarded and a control  
3 packet is prepared by the microcontroller where the control packet  
4 contains information indicative of characteristics of a DTMF signal and the  
5 control packet is coupled to the network interface for transmission over  
6 the IP network.

7 20. The apparatus according to claim 19, further comprising:  
8 a second network interface coupled to the IP network at a remote location;  
9 a second microcontroller coupled to the second network interface;  
10 a digital-to-analog converter coupled to the second microcontroller for converting  
11 digital representations of audio signals to analog signals; and,  
12 a DTMF signal generator coupled to the second microcontroller for generating  
13 DTMF signals having characteristics determined by information contained  
14 in a control packet.

15 21. The apparatus according to claim 19, further comprising:  
16 a second network interface coupled to the IP network at a remote location;  
17 a second microcontroller coupled to the second network interface;  
18 a digital-to-analog converter coupled to the second microcontroller for converting  
19 digital representations of audio signals to analog signals; and,  
20 a second digital processor operative to generate DTMF signals having  
21 characteristics determined by information contained in a control packet.